ELECTRICAL REVIEW

[ILLUSTRATED.]

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Storage Batteries.

BY DR. GEO. H. BENJAMIN.

FIRST PAPER.

(Prepared for the ELECTRICAL REVIEW.)

I propose to consider the storage battery from a purely practical stand-point, and to describe in as simple language as is possible what it is, how it is made, and how to treat it.

Of the history of the storage battery, I shall have nothing to say, except in so far as relates to describing the improvements which have been made from time to time. Neither shall I in anywise consider the claims of alleged inventors or owners of patent rights.

The storage battery may be defined as an apparatus for receiving the energy of the electric current, and for giving it out again in the same form.

Storage batteries which have come into general use may be divided into four general classes:

I. Those in which the electrodes are of similar oxidizable metals or metallic compounds.

II. Those in which the electrodes are of dissimilar oxidizable metals or metallic compounds.

III. Those in which the electrodes are, one of an oxidizable metal or metallic compound, and one of a non-oxidizable material, such as carbon.

IV. Those in which the electrodes are, one of an oxidizable metal or metallic compound, one a metal oxidizable or non-oxidizable and an electrolyte, consisting of a metallic salt in solution.

All the different types of batteries which have been suggested may, when finished and ready for work, be classed under one or the other of these heads. Extended experience has demonstrated that batteries of Class I are the best in all essential particulars—in fact, being the only ones which have proved to be commercially practicable.

Fig. 1 shows the simplest conceivable form in which *A* is a glass-containing vessel; *B B'*, the positive and negative electrodes; and *C*, a solution of sulphuric acid in water as the electrolyte.

In order to avoid confusion, the + electrode will always be called positive, and the — electrode negative, although electrically they are the reverse.

Such a device is of itself electrically inert;

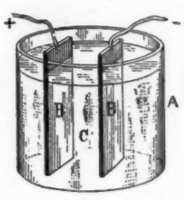

FIG. 1.—SIMPLE FORM OF STORAGE BATTERY

we may unite the electrodes through the connecting wires and no current will flow, and simply because the electrodes are of similar metal. If we were to substitute a plate of zinc for the leaden plate *B* or *B'*, we would, on joining the terminal wires, have evidence of a feeble current, but our device would then be a primary battery, and the flow of current would be due to the difference of potential between the two metals, lead and zinc, in dilute sulphuric acid.

With the electrodes both of lead or other metal, they will be, as stated, electrically inert, but not chemically inactive, for the reason that the lead (which we will consider as a typical metal for the purposes of description), is slightly soluble in the solution of sulphuric acid employed. In other words, the solution of sulphuric acid will attack the lead, until its chemical affinity for the lead is satisfied. This fact is practically evidenced by the thin layer of white sulphate of lead which forms on the surface of the leaden plates. If the lead be pure, the decomposition will be slight; but if mixed with any other metal or impurity, a decomposition will occur which will depend in amount upon the character of the metal or material mixed with the lead. The decomposition will be slow but sure, for here we have all the elements of local action.

This decomposition of the lead by the electrolytic solution is, without question, the greatest source of trouble in storage batteries.

Where lead or other metal has been acted upon, electrically or otherwise, to form an oxide upon its surface, as clearly shown in Fig. 2 on this page, it is found that there is a difference of potential between the metal and its oxide. In other words, the metal will be electrically positive as to its oxide. Here we have a condition similar to that where the metal was mixed with other metals as impurities—all the elements of local action, lead electro-positive, lead oxide, electro-negative.

If a plate so prepared be plunged in a solution of sulphuric acid and left standing for some days, it will show a condition similar to that shown in Fig. 3. That is, the surface of the oxide will be covered by a layer of sulphate of lead, formed as previously described; and there will also be a layer of lead sulphate between the lead oxide and the lead plate. Lead sulphate is a non-conductor of electricity, and its production in a storage battery decreases the power of the battery directly in the proportion that it is formed.

If a plate of lead having an oxide of lead upon its surface, be taken and inserted into a solution of sulphuric acid as one electrode, and a plain plate of lead is used as the other electrode, and the terminals united, no current will flow. Why? There is certainly a difference of potential between the lead as one electrode (positive) and the lead and lead oxide as the other electrode (negative).

In fact, I have just stated that with such as the conditions that there were all the elements of local action, and consequently the necessary elements to generate current. The answer is, simply because the lead plate of the negative electrode is not chemically clean. It has been, in fact, more or less oxidized and carbonated by the air and its gases, and there is consequently no difference of potential between the two electrodes. In order to test this question, if we take a plain negative electrode and subject it to the influence of hydrogen gas, and then replace it in the solution connecting the terminals, as before, we find that now we get a feeble current, but which will soon stop. If we remove the plate again and use it as the cathode of an ordinary electrolytic cell for the decomposition of water, hydrogen being liberated at its surface, and then replace it in opposition to the oxidated plate, the terminals being connected,—we find now that a current, having an electro-motive force of about 2.25 volts will flow, which is the theoretical difference of potential between lead and lead oxide. Why this great difference should be is not fully understood. We saw that where hydrogen gas was employed, the plate was made but slightly active. Why, then, should nascent hydrogen make such a difference? Formerly it was supposed that the lead occluded the hydrogen; analysis however, shows no trace of hydrogen. The true reason is not known. Personally, I incline to the opinion that the oxides and carbonates formed by the impurities in the air on the surface of the lead are not fully removed by the hydrogen gas treatment, but are entirely reduced to metallic lead by the nascent hydrogen evolved.

Fig 4 shows the electrodes of a battery in a condition to do work, that is to be discharged, lead and its oxide forming the positive electrode, pure hydrogenized lead the negative electrode.

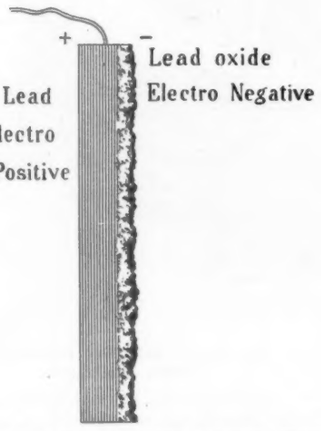

FIG. 2.—PLATE OF STORAGE BATTERY, SHOWING OXIDE OF LEAD UPON SURFACE.

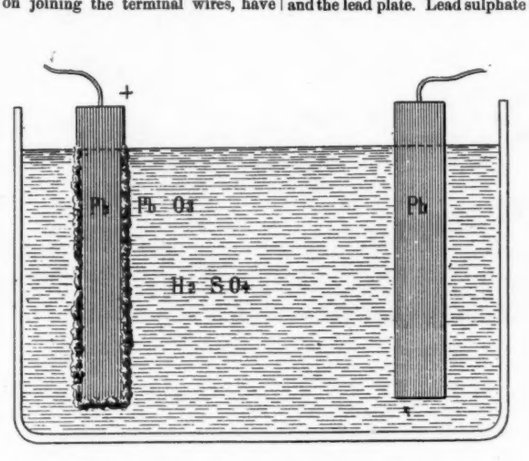

FIG. 4.—STORAGE BATTERY IN CONDITION FOR USE.

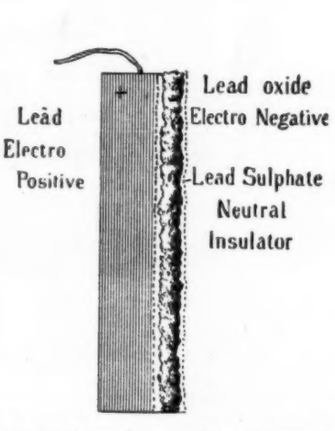

FIG. 3.—PLATE SHOWING LOCAL ACTION OF STORAGE BATTERY.

Electrical Transmission of Force.

A dispatch from Paris, July 26, says: The Rothschilds some time ago gave M. Marcel Deprez unlimited credit for the prosecution of researches in the problem of the electrical transmission of force. The results of the researches have just been submitted to a committee of inspection composed of 38 scientists, and the committee by a unanimous vote has approved the report, and pronounces the results obtained by M. Deprez worthy of the highest congratulations.

An Electrical Tachometer.

The electrical tachometer of Dr. Horn, of Leipzic, is based upon Arago's well-known observation, that a magnetic needle suspended over a rotating copper disc, is deflected in the sense of the rotation. To render the device practical, Mr. Horn replaces the weak earth magnetism by the field of a strong steel magnet of the ordinary horse-shoe type, the needle by an I-shaped armature of soft iron, and the copper disc by a strong copper capsule. The armature needle moves in the plane of the magnet inside the rotating capsule. As the Foucault currents induced are proportional to the intensity of the field and to the velocity of rotation, and as the magnetic moments with which the needle is drawn back to its normal position at least between the limits of zero and 45°, are also proportional to the angles of deflection, the deflections will be proportional to the speed. The gauging of the instruments is done experimentally. In the smaller instruments the needle is 2 inches long, and the diameter of the copper capsule a little greater. The axis of the revolving capsule may be fitted with a three-cornered top to fit into a corresponding cavity in the revolving shaft. Experiments on a minor scale have convinced Mr. Horn that small variations in the intensity of the magnetic field will not influence the deflections of the needle.

Police Telephone Patrol.

During the past six weeks workmen have been busy erecting booths at various points in the First Precinct, Brooklyn, and their labors are now complete. There are in all sixteen of these booths. They are octagonal in shape, are about 7 feet high and have glass tops. Above each one is a glass lamp. These booths are part of a system which has found much favor in Chicago and other Western cities. Frank C. Mason, superintendent of the Telegraph Department, has had charge of the practical part of the undertaking. He has made a complete success of it, and if this system has any inherent merits they will be made patent in this city, if anywhere. By the erection of these booths it is expected that the efficacy of the police force will be doubled, when the system is applied to every precinct, as it eventually will be.

Inside the booth is an oblong iron box, the dimensions of which are 8x12 inches. Protruding from the right hand side of this box is a hook. When a citizen or an officer is of the opinion that the patrol wagon is needed he pulls down this hook and the information is flashed to the sergeant at the desk. Inside this iron box is a full rigged telephone, and there is also a dial on which there are six divisions, marked as follows: No. 1, patrol wagon; No. 2, telephone; No. 3, riot; No. 4, ambulance; No. 5, fire, and No. 6, test call. There is a pointer on this dial which must be placed opposite the call which it is desired to send. Then the outside hook has to be pulled down and the operation is completed. The telephone service of this new system is in every way satisfactory. Speaking in a low voice the reporter talked with the sergeant at the First Precinct, and heard his replies as distinctly as if he were by his side. The wires are what is known as copper insulated, of 12 gauge, and were introduced at the special request of Mr. Mason.

Scrap Tin.

The utilization of scrap tin has exercised the minds of many inventors, who have seen a fortune in it, if they could only separate the covering metal from the sheet of iron beneath it. It is estimated, says *Engineering*, that the supply of old and scrap tin at London, Birmingham, Swansea, Wolverhampton, Truro, Liverpool and Glasgow amounts to 30,000 tons per year, and that this can be obtained at 5s. per ton, or less. Of this weight, five per cent. is pure tin, which in ingot form is worth £95 to £100 per ton, while the iron, separated from the tin, is worth about 40s. per ton. Hence twenty tons of scrap, which can be bought for £5, would realize, when the two metals are separated, at least £130, a sum which allows a very good margin to cover the cost of the manufacturing operations. A company, called the Electro Metal Extracting, Refining and Plating Company, of 76 Finsbury Pavement, E.C., has been formed to carry out a new process, by which the tin is stripped from the iron in a perfectly pure form, while the foundation plate is unattacked. The scrap is placed in a series of baths, through which a current from a dynamo is sent; and while there the white metal is dissolved, and is afterwards recovered in metallic state. It is said that the operations are so inexpensive that a profit of £79 is realized from the treatment of every twenty tons of scrap. The process is also set forth as being applicable to mining refuse, tailings, and slags containing gold, silver, copper, tin, etc., as well as to plating metals with zinc.

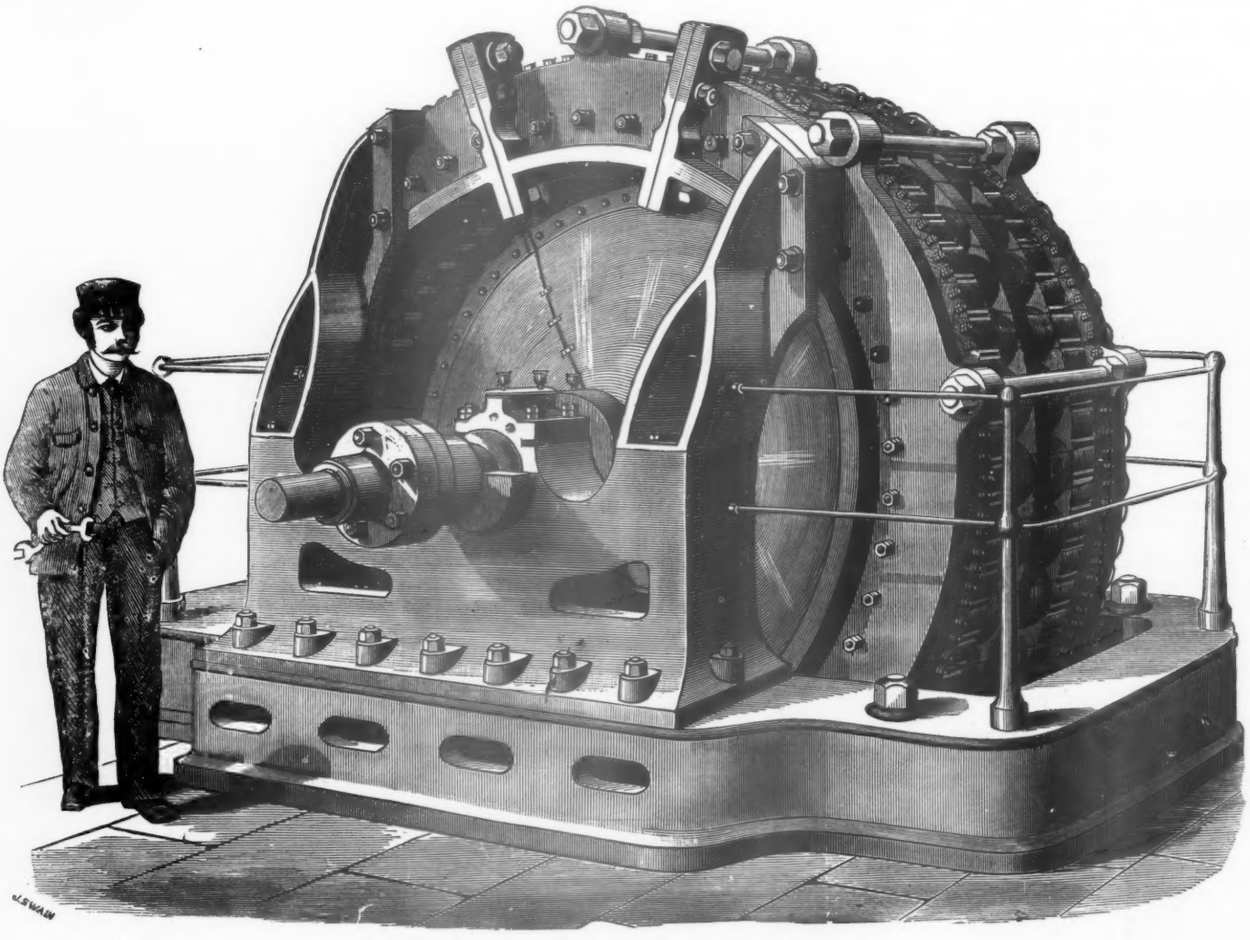

FIG. 1.—PERSPECTIVE VIEW OF GORDON DYNAMO—PADDINGTON.

Electrical Notes from Niagara.

Editors Electrical Review:

Some five years ago a company was formed here to furnish arc lights, using water-power and a 16-light Brush 2,000 candle-power arc machine was purchased. This plant was separate from and independent of the isolated plant which lighted the grounds of Prospect Park. The business has increased steadily until at present there are in addition two 45 lighters, old style, and the old 16-lighter with improved armature furnishing 30 lights. There are now in use arcs at Niagara Falls and on the Canada, 100 in all. 200 incandescents on the Brush multiple series cutout are used in stores, offices and on the old Suspension Bridge. These lights give great satisfaction, and the number will be largely increased as soon as the company can place the improved armatures in their larger machines. At the old bridge the appearance is that of a multiple series system. During the coming year the circuits may be extended to Tonawanda, and perhaps to Buffalo. The power is obtained from water wheels using only a part of the fall. The water is taken from the canal, which supplies the water works and a number of factories. To utilize even a portion of the fall, bronze wheels are required, those made of iron breaking readily. There is some talk of equipping the horse railroad with electric motors and steps with a view to accomplishing that will probably be taken during the next year. There is probably no place where the power for a street railroad could be obtained at less expense.

Niagara, N. Y., July 31, 1886.

The Great Paddington Incandescent Station Illustrated.

The Paddington, England, installation is a remarkable one in many respects, and is probably the largest incandescent installation in all Europe. A central building, not a large one, contains the machinery for the generation of energy, which is distributed and utilized as light in a district one and a half miles long and covering about 70 acres of ground. Within the district there are over 4,200 lights; in exact detail there are 4,115 incandescent lamps of 25 candle-power each, 98 arc lamps of 3,500 candle-power each, and two arc lamps of 12,000 candle-power each.

The dynamos used are illustrated in this issue of the REVIEW; also, several of the important elements that contribute to this extensive installation. Figs 2 and 6 are from photographs of the dynamo room before the machines were incased in their wooden houses (described and illustrated in our issue of July 24th), but will, however, give a very good idea of the external appearance of these large machines. Three of these dynamos are used, each weighing 45 tons, The sole plates are 18 feet long, and the revolving magnet-wheels are 9 feet 8 inches in diameter, and

weigh 23 tons each. They run at a uniform speed of 146 revolutions per minute. The dynamos are of the alternating current type, wound to give an E.M.F. of 150 volts. The field-magnets are excited by three Crompton direct-current machines, each of the latter driven by a Willans engine, while each of the former is driven direct by compound tandem engines by Rennie.

In Fig. 5, on page 7, is shown the divided main apparatus, which is considered the important part of the system, for by its use the quantity of the copper required in the feeding mains is reduced to one tenth of that used in the ordinary method. The principle of this is described as follows: In any feeding main the electric pressure at the far end is less than that of the dynamos. The fall of pressure is greatest when all the lamps that the main has to carry are on. If the main is thick and expensive this maximum fall is small; if thin and cheap it is great. When only a few lamps are on the fall is very small. Thus as lamps are turned on and off there is in an ordinary main a variation practically equal to the fall. As only a variation of not more than two per cent. can be allowed, very thick mains have to be used on the ordinary system, so that the fall may not be more than two per cent. The object of the divided main system is to allow a fall of 20 per cent. to be used. For this purpose the feeding main consists of a bundle of wires, as shown at *A A*, Fig. 5, connected into one at each distant feeding center. There are five of these distant centers in the district, and they are supplied by twelve feeding mains. Contact apparatus worked by wheels in the gallery allows the component wires of each feeding main to be disconnected one by one. As the wheels are turned round, more or less of the component wires are used to form the main cable. Fine wires come back from each feeding center to the gallery and actuate voltmeters and pilot lamps so that the exact brightness of the light in every part of the district can be seen in the gallery. Suppose, now, a certain number of lamps are switched off in, say, the hotel, its pilot in the gallery brightens a little and calls the attention of the attendant to the voltmeter. He then moves the contact wheel, and, cutting out a segment of the main, reduces its total section, and so increases its resistance and brings back the pressure to its normal value.

To sum up, the thickness of an ordinary main is constant, and, unless it is very large, the variations of current caused by turning lamps on and off cause variations of electric pressure. In the divided main the section is variable, and is kept always proportional to the current the main has to carry, and so the electric pressure is kept constant with a main of one-tenth of the section required for the ordinary system.

A double system of mains is laid throughout (not twice the necessary quantity of wire, but instead of one main of a certain section two of half that section), and in every room, building, yard, etc., half the lights are on one circuit and half on another, and these two circuits are worked by different machines, so that in case of either system breaking down no single room would be left in darkness. In some of the bed-rooms of the hotel, where only one lamp is paid for, two are erected on different circuits, and a switch is provided so that either can be lighted at the desire of the inmate, but not both at once.

Fig. 7 gives a good idea of the appearance of the dynamo switchboard. The different plugs communicate within various corridors, platforms, etc., by means of wires. Each has its one fuse, which can be disconnected so as to instantly localize any fault. There is also a means of measuring the current taken at any moment at any corner or any pair of arc lamps. The signaling apparatus used consists of two little solenoids (shown in Fig. 3), one in circuit with each of the signal lamps. A domestic meter is shown in Fig. 4. It consists of solenoids which pull cores into them against a counter weight according to the number of lamps at work. This, as they are drawn in, causes a snail wheel to revolve, and increases the distance from the upper edge of that wheel to a point vertically over it. A train of clockwork causes an arm to fall every quarter of an hour from a fixed point to the then position of the upper edge of a snail wheel. If no lights are on it falls no distance. If many lights are on it falls a distance proportionate to the number. As the arm rises again it engages a train of counting wheels. Thus the meter consists of a free galvanometer and apparatus which searches every quarter of an hour for the position of the galvanometer needle and adds together the lengths of all the journeys which it makes in those searches in, say, three months. The clockwork is not wound up, but is driven by a tuning-fork, actuated by a fine wire magnet into which the alternating current is admitted. It runs at a uniform speed whether few or many lamps are on; but when no lamps are on, the balance weight of the cores lifts a contact spring and stops the clockwork, so as to save wear and tear.

Some idea of the magnitude of the work may be formed from the following miscellaneous figures: 500 miles of wire have been used. The wires in the office and corridors are enclosed in wood casing. Of this 12 miles have been used. The casing is fixed to the wall by 94,000 screws. The underground mains are contained in thin iron troughs, like rain-water gutters with lids; of these 140 tons have been buried. About 25,000 joints have been made; 20 000 labels have been used for ends of wire; 2 tons of terminal and connectors have been used; 260 yards of massive masonry (in a number of short lengths) have been built under the lines to prevent the weight of the trains crushing the mains where they cross under the lines. The incandescent lamps are all in parallel.

The absence of noise is one very noticeable feature in this central station. It is almost impossible to distinguish any noise, even in the next room to the dynamos when they are running at full speed. The effect of enclosing the machines is wonderful, and one of the most satisfactory items of detail. The installation is a most creditable one, and was put in under the management of Mr. Gordon.

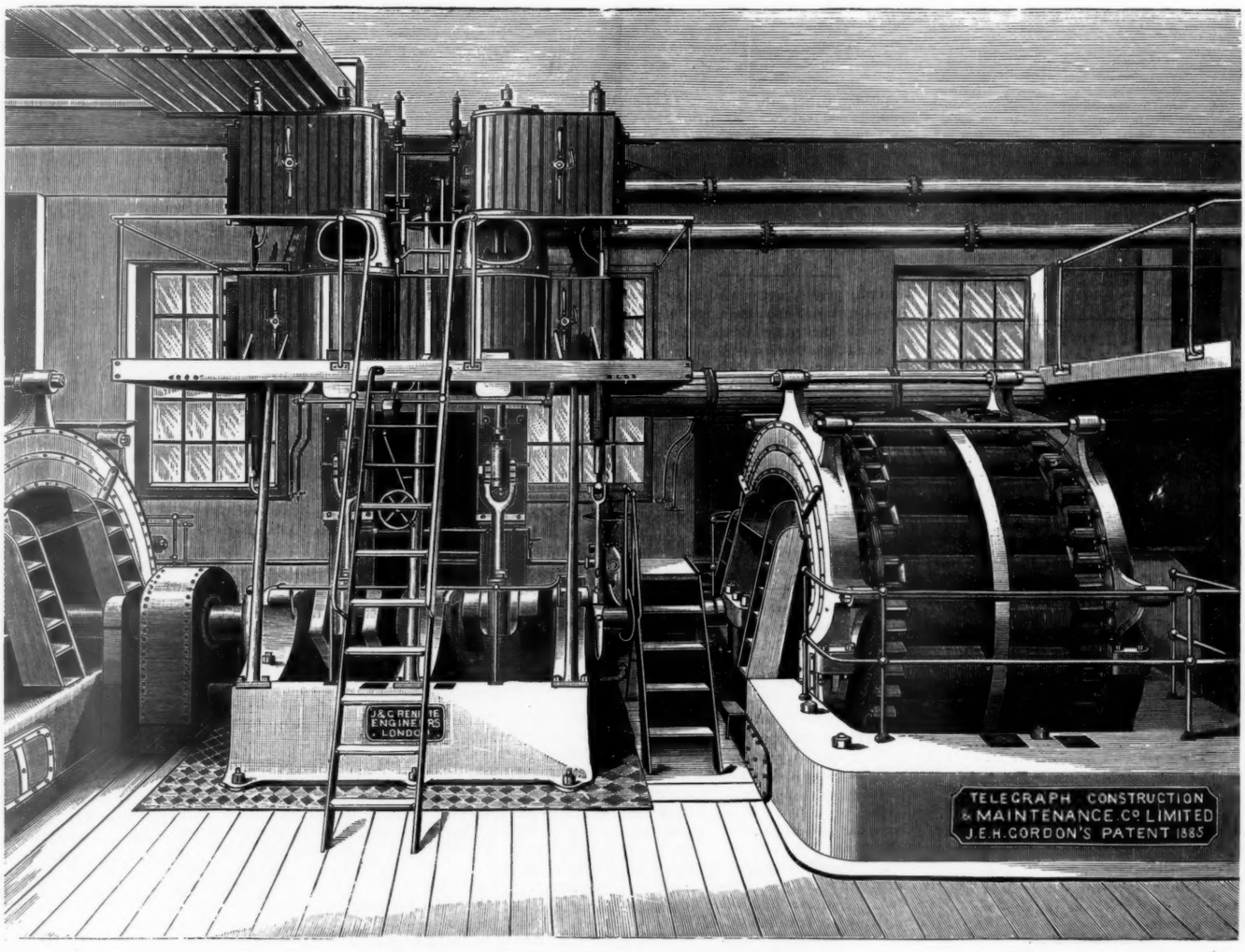

FIG. 2.—VIEW OF DYNAMO ROOM AT THE PADDINGTON STATION.

A New Alloy of Aluminium.

The applications of aluminium are now considerable, and M. Bourbouze, a French physicist, has added to their number by employing an alloy of the metal with tin for the internal parts of optical instruments, in place of brass. The alloy he employs consists of ten parts of tin and 100 parts of aluminium. It is white like aluminium, and has a density of 2.85, which is a little higher than that of pure aluminium. It is, therefore, comparatively light, which is an advantage for apparatus where lightness is desired. It can be soldered as easily as brass, without special means, and it is even more unalterable than aluminium to reagents. The attention of electrical instrument makers should, therefore, be called to it, especially for apparatus of a portable character.

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We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity and those engaged in Electric Lighting on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

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We hear all sorts of rumors of wonderful storage battery street cars—street-car storage batteries, battery street car storage—but we are getting mixed.

The ubiquitous Col. T. J. Montgomery, of Brush Company fame, has, we hear, deserted his first love, electricity, and is now devoted to gas.

A dividend of $1.00 per share has been declared by the Missouri & Kansas Telephone Company. In their comparative statement, they make the following good showing: "During the last three months we have built seventy-five miles of extra territorial lines, using No. 10 hard drawn copper wire. The aerial cable capacity of our Kansas City exchange has been increased from 1,600 to 2,200 subscribers, and switch board capacity from 1,400 to 1,600 subscribers. Our expenses were increased $1,600 on account of the damage done our Kansas City exchange by the cyclone of May 11th. The net earnings for the first six months of 1886 have been $46,560.15, while for the first six months of 1885 they were $31,840.89, an increase of $14,719.96."

Will all our advertisers kindly send us their registered cable address? We intend shortly to publish such a list.

We understand that Mr. Albert Swan, of the Vitrite Company, London, will shortly visit this country in company with Mr. Theo. Mace of the Vitrite and Luminoid Company, of New York.

The members of The Electric Club, of New York, deserve the honors they won on their first fishing excursion, the only drawback consisting in the fact that the fish seemed to prefer to be hooked anywhere but in the mouth. It takes an expert to catch fish *a la* seine with a hook.

Paterson, New Jersey, is enjoying a peculiar little piece of excitement, afforded by a man who does not like the electric light. Paterson is a city that has a good pavement and the electric light, but one man who does not admire the electric light is determined to stand in the way, and so there is a repetition of the comic spectacle of one body who imagines himself of more account than everybody. He has been enjoined.

Frequently, if not oftener, an inventor of a thermo-dynamic electro-static double-back-action flying machine drops in upon us. One called the other day and left three tickets, entitling the holders to seats in his machine on its trial trip from the top of the Mills building, on Tuesday next. Would any of our electrical friends like them? We are not well, and must be out of town for a few days.

Electricity plays a part in a mild sort of a humbug perpetrated upon the indulgent public that visit Manhattan Beach. Near the music stand is a battery of light artillery, mounting ten guns, which are supposed to be fired through the medium of electricity, and by the touch of the irrepressible Pat Gilmore, thereby adding their thunder to the music of the band. In point of fact, the guns are not discharged at all, the detonations being due to electric explosions of small charges of dynamite, placed conveniently near the guns. The humbug is practically concealed in the ensuing smoke. Devious are the ways of men, particularly at Manhattan Beach.

Electricité of last week publishes an engraving which purports to show the interior of a cabin of a Pennsylvania railroad ferry boat, and especially illustrative of the United States Electric Light Co.'s system of lighting. The artist has evidently a wide acquaintance with American manners and habits. The central figure of his picture is a very large colored woman, bandana upon her head, in earnest conversation with two white dudes. To the left appears a small Italian boy, engaged in furnishing music for the occasion; and immediately in front is a small boy arrayed in an Eton collar and plug hat, who gazes pensively upon the scene. If the artist will come to America, we will try and find a place for him, where his imaginative ability can have full scope.

The increase in the circulation of the ELECTRICAL REVIEW during the past twelve months has excelled our most sanguine expectations. This is, indeed, gratifying, proving conclusively, as it does, that an independent journal, presenting all the important news in this field, and discussing events in an impartial and intelligent manner, deals with an appreciative constituency. In all the paths of journalism we do not think there is a more intelligent and enterprising fraternity to be met with than the one composed of gentlemen engaged in electrical work. They are alert, earnest and progressive, and the REVIEW is proud to have them for its weekly auditors. One chief idea has prevailed with the conductors of this journal since its first number—to make it worthy of the support and confidence of the best elements in its field. That it has secured this its success proves.

Still, there is room for more. No one who desires the leading publication in the electrical field need hesitate to send us his name for fear of over-crowding our circulation lists.

WORTHY YOUR ATTENTION.

The next meeting of the National Electric Light Association will be held in Detroit on the 31st of this month.

All reports to this office indicate a large attendance, particularly from the West. Every Eastern member, as well, should be present.

Excellent arrangements, we are assured, have been made for the accommodation of all visitors to Detroit on this occasion. The object of this article is to most earnestly urge all who are interested in electric lighting to be present. No former programme has been so instructive and important as the one promised for Detroit, and we hope to see the intelligent work of the managers fully appreciated.

In issuing the editorial call for the first meeting of the electric light fraternity, some eighteen months ago, the ELECTRICAL REVIEW encountered the opposition of several of the parent companies, and did not receive the support of a single electrical contemporary; yet, to-day, all these elements are in favor of the organization, and we trust are loyally working for its continued advancement and success. Most happy in its selection of capable officers, at the first meeting in Chicago, the Association has continually increased in strength and influence, and, above all, in benefit to its members.

Again we ask you, if you are interested in the advance of electric lighting, and are not a member of this Association, to send in your application at once,

A GAS COMPANY FORSAKING EVIL FOR GOOD.

It is a curious sign of the times that the gas companies are beginning to go into the electric lighting business. It furnishes, too, still another proof that the devil is not as black as he is painted; that even gas monopolists are not lost beyond the hope of redemption, being willing to earn an honest livelihood if only some one will show them the way.

In the present instance, it is the Austrian Minister of the Interior who has indicated to the Imperial Gas Association, of Vienna, a means whereby its projectors can furnish full equivalent in light for the money the public pays into its coffers.

Our contemporary, *Bulletin International de L'Electricite*, says:

"The Imperial Gas Company, of Vienna, has been authorized by the Minister of the Interior to establish a central electrical station, with sufficient power to supply 4,000 incandescent electric lights to the Grand Opera House, and 3,000 lights to the Court Theater. The concession is for twenty years. For this service the company is to receive 150,000 francs—$30,000."

We would suggest to the Imperial Gas Company, of Vienna, that it supply the furnaces of its central station with its own gas as a fuel instead of coal, and thus put the fact on record for the use of future historians that there was at least one instance during the nineteenth century of a gas consumer who was not overcharged in his bill.

They will discover that gas, as a fuel, is much cheaper and more convenient than coal, when the value of the residuents is considered; and, finally, they will have the novel experience of giving satisfaction to the public using their light.

ELECTRICAL SECTION OF THE SOCIETY OF ARTS, BOSTON.

The Society of Arts is an organization which is a portion of the Institute of Technology in Boston, and hold meetings every alternate Thursday evening from October to May inclusive. The first meeting was held in April, 1862, and they have been continued up to the present date. Papers generally upon popular scientific subjects are presented at these meetings, and receive the benefit of a discussion among the members of the audience.

During the last year consideration has been given to subjects of great interest to the community. On electrical subjects Mr. W. W. Jacques, of the American Bell Telephone Company spoke upon the recent progress in underground wires.

Lieut. F. J. Sprague, of New York, spoke upon electrical railways.

Mr. A. H. Cowles, on the production of aluminium and its alloys by the electric process carried on at Cleveland, Ohio.

Other topics have been upon the relative poisonous properties of coal and water gas; the distribution of steam in cities; improvements in steam heating; application of solar heat in warming buildings; transmission of power by belting; the supply of natural gas; matters of interest in the manufacture of steel; in the water supply of cities; on labor difficulties and arbitration; on chemistry of foods in nutrition; on the dynamite gun, and the use of high explosives in warfare; and other subjects covering a wide range of topics of great importance and interest to every member of the community.

The question of electricity is one which has received a wide interest not only among electricians but by persons of general scientific information; by those who have investments in various electrical inventions and discoveries; and also by those attorneys who have had to deal with deep and complex questions arising in patent litigation.

This subject has received a great deal of attention on the part of the members of this society; and an electrical section was formed last spring for the purpose of giving special consideration to the questions arising in relation thereto; and it is proposed to hold special meetings; and also to devote certain regular meetings during the coming season to electrical questions.

The second meeting of the society, next October, is to be the first of the electrical meetings.

As there is not at present any distinctively electrical society in Boston, the Society of Arts affords an especial opportunity to electricians for meeting, and conference upon electrical subjects. These meetings are always open to the public; and the membership involving the privileges of voting and discussion is easily obtainable.

TIMID ITALIAN TELEPHONISTS.

Italy, as we know, is far behindhand in matters telephonic. Addresses have, from time to time, been sent to the government by merchants and manufacturers asking that some sort of service be established without further delay. The only result up to quite recently has been to renew the discussion which for a whole year has occupied the attention of the Italian chambers as to whether the government should absorb the telephonic service as it has the telegraphic, or whether, there being seemingly, so much risk of loss, concessions and patents should be sold or rented to private parties. Generally speaking, it would seem as if the Italian people, like the Spanish and Portuguese, are scarcely ready yet for the telephone. In the larger cities some feeble attempts have been made toward the organization of a general telephone exchange, but the success so far had scarcely warranted the hope that any save the few, the larger merchants and the rich are ready to avail themselves of the great benefits the telephone brings. Perhaps, as it is alleged by a French contemporary, the promoters of the telephone in Italy, have shown such temerity, such lack of energy and enterprise that those who would be benefitted by telephonic service are warranted in hesitating before putting down their names on the subscription lists. It seems that those who are seeking concessions from the government of territorial rights are unwilling to put out their money and establish their exchanges until enough prospective patrons have promised to subscribe, to make the venture a safe one.

There seems to be an excellent opportunity at least in the Italian cities, for some enterprising men who have sufficient confidence in human nature to supply a good thing before expecting to be paid for it.

UTILIZING WIND POWER IN ELECTRIC LIGHTING.

In last week's issue our correspondent, H. S. T., questions the expediency of the use of windmills for electric lighting, in the manner proposed by us in our issue of the 24th ult., and advances the following points in support of his position :

1. That the rate of revolution of the wind engine, according to varying force of wind, is too irregular to run a dynamo for the purpose of charging a storage battery.

2. That the wind cannot be depended on for more than about six hours' hard work per day, possibly not half of this.

We carefully considered the subject before writing the editorial in our issue of the 24th ult., and might inform our correspondent H. S. T. that our own experience with windmills radically proves him in error in the above statements, which form the bulwark of his criticism. But we prefer to cite higher authority—in fact, the highest authority on the subject—and therefore quote quite liberally from Wolff's treatise on "The Windmill as a Prime Mover," (New York: John Wiley & Sons, 15 Astor Place). In this excellent treatise, which exhausts the subject, and which is written from a thoroughly impartial scientific and practical standpoint, we read on page 73 :

"The several types of American windmills are characterized by the form of wheel, and the method of regulation or governing employed to vary the extent of the surface presented to the wind, so that a uniform power and a uniform rate of revolution may be obtained under varying velocities of wind. The two principal types may be distinguished respectively as the sectional wheel with the centrifugal governor and independent rudder, and the solid wheel with the side vane governor and independent rudder. In both types, the rudder brings the wheel into the direction of the wind."

Then follows accurate detail of the special forms of mechanism employed for governing, clearly proving that the slightest changes in the force of the wind cause corresponding but inverse changes in the extent of surface presented to the wind, so that the rate of revolution and the power exerted are practically uniform at every moment, within a large range of differences in the velocity of the wind. Certainly the uniformity is great enough for driving dynamo machines to charge storage batteries. In fact, we are informed on page 75 of Mr. Wolff's book, that "either of these two types of governing acts with sufficient accuracy and promptness to place the American windmill in the rank of reliable automatic engines."

As to the number of hours a windmill will run per day, we learn on page 8 of Mr. Wolff's book that "it has been found by experience that it requires, on an average, a wind of a velocity of six miles per hour to drive a windmill, and that the latter will run, on an average, eight hours per day; the average velocity of wind, during the eight hours of work, being equal to 16 miles per hour."

These figures are carefully substantiated, and further evidence of the performance and reliability of the windmill is detailed in the chapter on "The Capacity and Economy of the Windmill," viz., in the following table on page 133 :

On page 136 it is stated that "the performance of the thirty-foot mill, as far as observed, seems to gravitate to a pumping capacity equivalent to 2.4 horse-power, and to an expense of 2.5 cents per horse-power per hour."

Referring to the above table, Mr. Wolff mentions, on page 132 of his book, "over fifteen hundred windmills have been sold on its guarantee ; and in all cases the actual results obtained, both in this country and elsewhere, did not vary sufficiently from those presented to cause any complaint whatever—a proof that the results as calculated are correct, or certainly not too high."

As to the suggestion of H. S. T. to raise sand by means of windmills, and drive an overshot wheel by the fall of the sand, the wheel being arranged to run a dynamo directly, we scarcely think this plan would prove satisfactory in practice, though it might be worthy of trial as a matter of experiment. Personally, we fear that practical difficulties and irregularity of action will bar out this mode of application of wind power. The suggestion of H. S. T. to raise sand by means of windmills and apply it to the driving of overshot wheels, is, however, evidently not a new one, for on page 4 of Wolff's "Windmill as a Prime Power," we read :

"Sand has also been raised in place of water, and has been applied to the driving of an overshot wheel."

Finally, we are pleased to note on the same page of Mr. Wolff's book that "the application of the windmill for driving dynamo machines to charge electrical accumulators, first suggested in 1881, by Sir William Thomson, will," in his opinion, "soon come actively into play when storage batteries have been developed to a greater success than is attained at the present time."

We believe that the time for their application in this way is already at hand, and refer to our issue of the 24th ult. for further particulars.

CHICAGO ELECTRICAL NEWS.

The case of the Bankers' and Merchants' Telegraph Company against the Chicago Carpet Company, was disposed of one day last week, by the overruling of all but one of the exceptions to the master's report.

This was a bill filed by the telegraph company alleging it was insolvent, and asking the court to protect it against its own attaching creditors who had sold portions of its stock. A receiver was appointed and on his petition the case was referred to a Master in Chancery to determine the amount of claims against the company and their relative priority. The court in deciding the case thought the familiar principle of law would control that court which first by its process, got jurisdiction, would maintain the priority of right of its attaching creditors. The judge said that an order would be made requiring the B. and M. to pay into court the full amount of rental due the Board of Trade Company before the sale, or the possession of the property would be surrendered to the company.

Columbus, O., was struck by a severe hurricane at noon on the 30th. The storm lasted about forty minutes, causing a damage estimated at about $20,000. Several parties were caught in the debris of the Columbus Rolling Mill, which was blown down, one of whom is supposed to be fatally injured. The Union Depot, the Sash, Door and Lumber Company's works, and the Fifth Avenue school building were partially unroofed. Trees, telegraph and telephone wires were prostrated.

The Fort Wayne Jenney people have commenced the manufacture of incandescent lamps for their own use.

At Peoria there is a street lighting plant of four hundred lights. Peoria has been the Mecca of pilgrim agents of electric light companies for some weeks. Of course they went there for business. The business consisted in trying to oust the present company, and put in some other system. The gas people too, overflowing with patriotism, good will toward men, and all that sort of thing, has volunteered considerable advice relative to the best method of lighting the city. The cause of all this eddy and whirl of the elements is found in the fact that a new contract is to be made with somebody for lighting the town.

The Fort Wayne Jenney people, through their Chicago agency, have just closed a contract for a 60 light plant at Saginaw City, Michigan. Mr. W. J. Buckley did it.

Kokomo, Missouri, has just started an electric light plant of the T. H. variety, for street lighting.

The first Thomson-Houston lights on towers have just blazed out at Jacksonville, Ill. The plant is run by the gas company, and the lights are mounted on six of the Star Tower Company's iron towers.

At Lafayette, Ind., there is considerable amusement for the people growing out of a lively competitive circus which is billed there for the season. The gas company is using the T. hyphen H., as the boys call it, while the Brush people run a circuit of eighty-five 1,200 candle-power (estimated) lamps. Prices have been beared until the rate has got down to $6.50 per month. The Brush people have recently put in an additional dynamo and a new Buckeye engine to increase capacity for business.

In order to prepare for the grand military reunion at Tippecanoe battle ground, it was necessary, as is the rule in everything electrical, to leave all till the last moment, and then rush things. Of course, in such a jam no lineman could be found; and it is said to be very funny, on occasions like this, to see the president of the company, brown as a butternut, the blistered skin flapping on his nose, climbing poles, as agile as a trapeze performer in the "great and only;" or the secretary, doing the crossarm act with a strap round his waist filled with connectors and pliers and things, hanging on by the skin of his teeth and one leg, swaying away at the come-along strap like a maintop-man, singing in a good, full baritone—

"Hard away and around she goes,
So early in the morning."

Or that other little ditty about

"The sweet little cherub that sits up aloft,
To look out for the life of poor Jack."

It looks well, but there is a hereafter to all that sort of thing. When the excitement is over, and you come down to cosmoline and linen rags, cream and cotton batting, or boiled oil and tow, by way of repairs, and everyone you meet wants to know how many fish you caught, and refuses to believe your explanation, then there is no poetry to the jolly life of an amateur lineman.

Mr. C. H. Cone, of the Electrical Supply Company here, has just returned from a long trip, first to the Pacific Coast and then through the South, and returned loaded with orders. He will now remain for a time on the city trade before again taking to the road.

In the course of changes on the West side, a central plant of eighty or more lamps, formerly a Van Depoele, has been purchased by the T. H. Company. The present proprietors have made some changes in the methods of doing business with customers, and, of course, introduced their own style of lamp. Naturally there is more or less metaphorical hair pulling and face gouging temporarily, threats and hard words, but it will all quiet down, and the plant will continue to do business at the old stand as heretofore.

CHICAGO, Aug. 2.

Wrinkles — Electrical and Otherwise — Practical Information.

To make a good soldering liquid, into hydrochloric acid place as much scrap zinc as it will dissolve, still leaving a sponge of zinc. Use the mixture for soldering brass work. To solder cast or wrought iron, add sal-ammoniac ; and for sheet tin work, omit the sal-ammoniac.

To clean steel and iron from temporary and slight rust, cocoanut husks are better than waste and turpentine.

Black color for zinc.—Clean the surface with sand and sulphuric acid, and immerse for an instant in a solution of sulphate of nickel and ammonia 4 parts, in water 40 parts, acidulated with sulphuric acid 1 part. Wash and dry. This takes a bronze color on burnishing.

True aluminum bronze contains 90 to 95 per cent. of copper, with 5, 7½ or 10 per cent. of aluminum. It is of a golden color when the proportion is 5 or 10 per cent., and greenish if the proportion be 7½ per cent.

Horse-shoe magnets are made by placing on each end of a hardened steel bar a soft iron cylinder, and surrounding the whole with a helix which is connected with the poles of a powerful battery. They are also made by placing the hardened steel bar against the face of a strong electro magnet.

To make a simple galvanic battery take a glass tumbler and place in the bottom a sheet of copper, having an insulated wire attached and extending out of the tumbler. Cover the copper with blue vitriol, and suspend a sheet of zinc near the top. Fill the tumbler with water. Connect the zinc and copper together for 49 hours, and the battery will be ready for use.

Zinc may be cleaned, like iron, with a dip into stronger acids before the final washing.

A fine lubricant oil may be prepared as follows: Digest olive oil for about thirty days with a quantity of clean lead turnings (sufficient to nearly fill the vessel); then filter the clear oil through twenty-four inches or more of clean granular charcoal (free from dust). Or, agitate good sperm oil by injected steam, for about half an hour; and after reducing its temperature to about 40° Fahr., press the fluid portion through several thicknesses of fine linen cloth; warm and filter as before.

To cut glass jars, fill the jar with lard oil to where you want to cut the jar; then heat an iron rod or bar to red heat; immerse it in the oil. The unequal expansion will check the jar all round at the surface of the oil, and you can lift off the top part.

The Electric Club Goes a-Fishing.

The Fishing Banks, near Long Branch, were depleted of fish to a more or less extent by the energetic fishermen of The Electric Club, who chartered a steamer last Saturday, and to the number of about thirty devoted the day to this fascinating sport. The president of the club, Mr. H. C Davis, and Mr. J. B. Powell, vice-president, commanded the excursion, which had been planned and arranged by a committee of the club, of which Gen. C. H. Barney was chairman. The boat was supplied with every comfort, the fish were fairly active, and everything passed off most pleasantly. The largest capture was made by Lieut. F. W. Toppan, who landed a flounder weighing either three pounds and eight ounces, or eight pounds and three ounces—a point of dispute. If it was the latter, it was about seven pounds heavier than the average of all the other fish. The most fish were caught by Major George W. La Rue, whose record as a successful artist with the fish line was well sustained. Everybody had fish enough and to spare, and enjoyed eating them aboard the boat, where they were prepared by an excellent cook, "in the highest style of the art." So well was every one pleased that another excursion is being planned for an early day.

TABLE
SHOWING CAPACITY OF WINDMILL.

1	2	3	4	5	6	7	8	9	10	11	12
	Designation of Mill.	Velocity of Wind in Miles per Hour.	Revolutions of Wheel.	Gallons of Water Raised per Minute to an Elevation of						Equivalent Actual Useful Horse-Power Developed.	Average Number of Hours per Day During which this Result will be Obtained.
				25 Feet.	50 Feet.	75 Feet.	100 Feet.	150 Feet.	200 Feet.		
I.	8⅓ ft. wheel	16	70 to 75	6.162	3.016	.....	.....	.....	.....	0.04	8
II.	10 " "	16	60 to 65	19 179	9.563	6.638	4.750	.....	.....	0.12	8
III.	12 " "	16	55 to 60	33.941	17.952	11.851	8.485	5.080	.....	0.21	8
IV.	14 " "	16	50 to 55	45.139	22.569	15.504	11.946	7.807	4.998	0.28	8
V.	16 " "	16	45 to 50	64.600	31.654	19.542	16.150	9.771	8.075	0.41	8
VI.	18 " "	16	40 to 45	97.682	52.165	32.513	24.431	17.485	12.211	0.61	8
VII.	30 " "	16	35 to 40	194.950	69.750	40.800	31.948	19.284	15,976	0.78	8
VIII.	35 " "	16	30 to 35	212.381	106.964	71.604	49.725	37.949	26.741	1.34	8

Telephonic News

⁂ Alfred F. Moore, of Philadelphia, has about completed an extension to his extensive wire and cable works which will more than double his present capacity. It will be ready to occupy in about ten days.

⁂ The Bell Telephone Company has entered suit to restrain the Cushman Company in Chicago, and some weeks ago enjoined the Interstate Company. These are two companies which sought franchises in that city.

⁂ Had not the telegraph or telephone been invented, homing pigeons would, no doubt, have acted as a means of communication between distant points. During the Franco-Prussian war over a million messages were sent by homing pigeons. These birds can fly 500 miles without resting.

⁂ Dr. Lucien C. Rose, of Ohio, has sailed for Gothenburg, Sweden, where arrangements have been made for a public test of his instrument, and his trip abroad is to enable him to be present at the test. Dr. Rose claims to be able to speak and hear with ease and satisfaction with his instrument over a distance of 2,500 miles.

⁂ A micro-audiphone has been patented by Mr. Frank M. Blodgett, of New York city. It is provided with a reed, made of thin metal slotted to form narrow strips, and placed within the inner chamber, to augment the sound waves, together with other novel features, the invention being an improvement on a former patented invention of the same inventor.

⁂ Mr. James A. Derrom, of Caracas, general manager of the Venezuela Telephone Company, is now in New York. At Caracas the company has a telephone exchange of 500 lines, and use the multiple switchboard of the Western Electric Company. Incandescent electric lamps are provided for the night operators, the Volta-Pavia batteries furnishing the electricity for the lamps.

⁂ At the annual meeting of the Rocky Mountain Bell Telephone Company, held at Salt Lake City, July 21, the following named were elected for the directors for the ensuing year: J. J. Dickey, Thomas Sherwin, C. W. Lyman, H. C. Hill, C. F. Annett, George Albree, Geo. Y. Wallace, George M. Scott, Chas. S. Smith. The officers of last year were re-elected, viz: C. F. Annett, president and general manager; J. J. Dickey, vice-president; Chas. S. Smith, secretary; Geo. Y. Wallace, treasurer.

⁂ The New York office of the Electrical Supply Company is in receipt of most gratifying business, notwithstanding the fact that this is the quiet season of the year. They have recently brought out an annunciator that is meeting with great favor; also their new iron frame and box bells. The increase of business secured by this company compelled the construction of additional factory room at Ansonia, and much new machinery has been added, and is still being put in on account of the demands of trade. The New York branch of this house is succeeding splendidly under the wideawake management of Mr. H. P. Hungerford.

⁂ There are two systems of telephone exchange in the city of Fort Worth, Texas, the Bell and the Pan-Electric companies. The Bell system, under the management of the Southwestern Telegraph and Telephone Company, commenced operations August 25, 1881, with 45 connections; January, 1882, it had 75 subscribers; January, 1883, it had 150; January, 1884, it had 225; January, 1885, it had 250, and now has about the same number. W. B. Elliott, the present manager, took charge of the system January 1, 1885. The territorial connections of this company commenced with Dallas in November, 1883. The places in Texas that can be reached by telephone over the wires of this company number about 150.

⁂ Mr. W. G. Roberts, for the past three years auditor of the Wisconsin Telephone Co., has resigned and gone into iron mining, and is reported to have met with a streak of good luck, which is liable to lead other telephone people into the same business.

⁂ A telephone wire became crossed with an electric light wire in Saratoga, and created considerable excitement. The end of the telephone wire fell to the ground, and was so heavily charged with electricity that wherever it touched a spark of fire was seen.

⁂ Mr. Edison in a recent interview says: "As soon as I can find time to go to Florida, I am going to make some experiments with earth currents. I cannot do it here, because there is too much mineral in the soil. In Florida it is all sand. There are currents of electricity passing all the time through the earth; their directions, however, are unknown. I propose to arrrange eight currents, radiating in as many directions from a central point. I will place a man at each circuit to test the power of the currents. It is well known that if an earth current crosses a wire at right angles, there is but little, if any, appreciable effect made upon it. The greatest power is found where the wire and currents run in parallel directions. In Boston I have run a wire six hours with the aurora borealis without a battery. If I had had a rod at that time running from New York to Boston, I would have had electric power enough on it to run all the machinery in Boston. A knowledge of earth currents may revolutionize the meteorological bureau system, and make it possible to forecast the weather exactly. I have an idea that it may do something still greater, but I do not care to talk about it at present. Telegraphic wires, sooner or later, will be a thing of the past, I believe. They are expensive and cumbersome, and why use them if you can make an instrument that will be sensitive to the natural earth currents?"

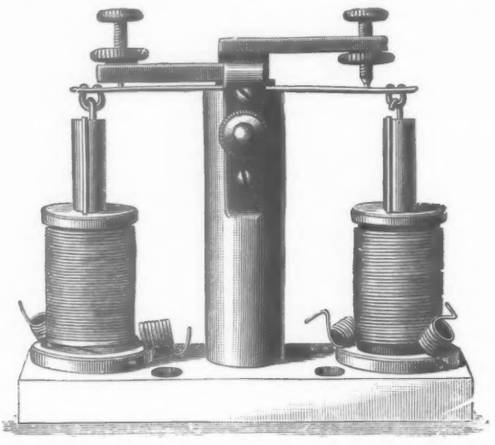

FIG. 3.—SIGNAL APPARATUS USED AT PADDINGTON ELECTRIC LIGHT STATION.

⁂ Besides its power of working simultaneously with an ordinary telegraph, or a telephone on the same wire, the phonoporic telegraph, invented by C. Langdon Davies, can be developed into a multiple telegraph by the well-known device of making the reeds vibrate to a particular note so as to send vibratory currents of one particular period. Several of these reeds, with their attendant transmitting and receiving apparatus, may therefore be used on one line, each sending its own particular vibratory impulses into the line; and these impulses would vibrate them on harmonic reeds at the other end of the line, thus working their own local receiver. In this way a number of independent phonoporic messages might be sent satisfactorily together on the same line.

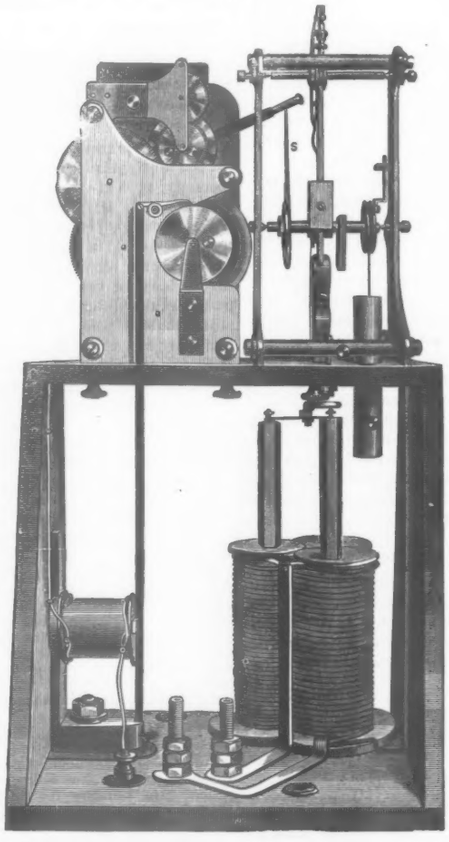

FIG. 4.—THE DOMESTIC METER USED AT PADDINGTON.

⁂ The Common Council of Lafayette, Ind., adopted a resolution rescinding its order of May 10, compelling the telephone company to remove its poles and wires from the streets and alleys. This resolution gives the telephone company permission to operate under the new system which is now in operation, by which each subscriber is made an agent of the company, and toll is collected according to the number of times the instrument is used. This is considered as final action in regard to the telephones in this city.

More About the Telphone Ear.

Editors Electrical Review:

I inclose you a startling piece of information, which I clip from one of our local papers. You had better take a whiff from your camphor bottle before you read it. Of course the inventor does not make metallic connection with the wire, as that is illegal.

His ear may work by induction, in which case it would require to be about 400 feet long. I doubt not both ears are long, but hardly of the required extent:

"An amateur electrician, of Norwood, claims to have invented an instrument that, when placed in the ear, will enable a person to take a telephone message at any point on the wire, while standing on the ground."

G. B. S.

Ogdensburg, N. Y., July 31.

Some Good Points About Handling the Telephone.

The use of the telephone in business is becoming so general that it becomes important to every man to have some knowledge of electricity and electro-mechanics. He need not be an electrician any more than he need be a veterinary surgeon should he own a horse, but he would be at a great disadvantage if he could not properly feed and harness the animal.

This article is an attempt to supply that information as clearly and briefly as possible, by describing the various ills the telephone is liable to, with brief directions for their prevention and remedy; as Dr. Pangloss would observe, "For this are we doctors."

The apparatus is so well known that no detailed description is necessary; but for the sake of convenience the subject may be considered under the following heads, which indicate the various components of a simple telephone system:

1. The conducting wire, or line.
2. The magneto bell, or signaling apparatus.
3. The transmitter, attached to which are one or two cells of battery.
4. The hand-telephone, or receiver, which is attached by a flexible cord.

The hand-telephone, or receiver, is one of the most sensitive instruments we have for detecting feeble currents, and with a little practice it may be made a general detector for all the faults the balance of the apparatus may be liable to.

First. The wire or conductor, if broken, will prevent the bell ringing; if the line is in the city or near a busy telegraph line, listening in the telephone will show whether the break be near or far, by the character of the ever-present induction.

When no such sound is heard, the bell should be tested by short-circuiting and ringing the bell and placing the telephone to the ear, tap the transmitter or blow in it; if the bell rings, and the sound or blowing or tapping is heard, all the connections in the apparatus are O. K, and the trouble must be looked for on the wire leading from the ground connection out through the bell to the pole or other supports, and hence to the further end. A ground on the line can only be detected by failing to get the answering signals from the next station, unless the line be very long, when the increased strength of

the ringing current is some indication. Crosses, or contacts with other wires are indicated by irregular ringing of the bell and abnormal scratching sounds in the telephone.

Second.—The magneto bell usually has a supporting device for the hand telephone or receiver, which by gravity acts as a cut-out for the talking apparatus or ringer (whichever the case may be), and also to open and close the battery on the transmitter. Formerly there was also a push-button either on the face side or bottom, which it was necessary to press simultaneously with turning the crank, in order to send the signals out on the line. This is almost universally superseded by an automatic attachment to the crank of the bell, which acts by turning the crank.

The faults common to bells are breakage of the fine wire connections which would be the same as a broken line, or imperfect contacts in the various moving parts of the switching devices, which may be caused by dust, corrosion or loosening of the parts. A careful inspection will usually detect the trouble, which, in most cases may be easily remedied by cleaning and tightening up. (Little or no oil should be used). Should the trouble be in the fine wire of the coils, either of the gong or armature, the bell should go to the shop—no amateur should attempt to unwind them.

Imperfect connections indicate themselves by diminished force in ringing the bell. Care should be taken to see that the attachment for supporting the hand telephone or receiver works freely, so that it goes up firmly when the telephone is taken off and down firmly when it is in place. In the first instance this trouble indicates itself by a scratching or frying sound in the telephone or receiver, and diminished sound of the communication; in the second the bells will ring feebly. A touch of the finger sets it all right.

The transmitter and its battery should require very little attention if properly adjusted when set up. As long as the battery is good it will give satisfaction. Its condition, as well as that of the battery, is readily determined by short circuiting and tapping or blowing in it. The condition of the battery may be determined by its appearance, and it should not fail as long as the jar remains two-thirds full of water and the zinc not consumed. When crystals begin to form in quantity on the prisms or porous cup and zinc, the battery should be renewed either by new zinc prisms or porous cups, or by scraping the old zinc, and soaking the prisms or porous cup in fresh water and setting it up with a fresh solution of sal ammoniac. Sal ammoniac should be used sparingly in maintaining the battery. Cleaning the zinc will usually do more good than a charge of sal ammoniac.

A little practice will enable any one to detect the condition of the battery by the sound in the telephone short circuited; a good battery gives sharp and decided sounds. All the connections in the transmitter are simple and visible, so that any disturbance is readily detected by the eye.

THE TELEPHONES AND CORDS.

The telephone itself seldom requires any attention; about the only fault it has is the melted paraffine running out and cementing the diaphragm, or the diaphragm becoming dented or bent, either of which interferes sadly with its efficiency. The paraffine is readily removed, but a damaged diaphragm can only be replaced by a new one.

The cords are liable to partial breakage at the tips, which is indicated by a scratching sound in the telephone when the cord is moved by the fingers, and it is usually detected in this way. Sometimes, however, it is a complete break, for which the only remedy is a new pair of cords, or wires, until cords can be had.

It should not be forgotten that the telephone will also act as a transmitter.

A good connection with the ground at both ends of the line is of vast importance. Where gas or water pipes are accessible, it is an easy matter; but in the country care should be taken to get to dump earth, and four or five feet in depth. A gas pipe driven in the ground or a drive well makes a good connection with the earth. The wire should be attached above the ground and soldered. A small wire will soon rust away at the surface line and make trouble unexpectedly.

The fine wire coils in the bell, transmitter and telephones are all liable to damage from lightning, and all precautions should be taken to protect them by short-circuiting when lightning prevails. Damage from this cause is usually so obvious and unmistakable that no instruction is needed to detect it.

Telegraph Reform in the British Empire.

At a meeting of the Congress of the Chambers of Commerce of the British Empire, recently held at the Indian and Colonial Exhibition, Sir James Anderson read a paper in which he proposed a reduction of telegraphic rates, the extension of telegraphs, the Government supervision of telegraphs, and the neutralization of cables in time of war, these being the subjects with which the Congress had primarily to deal. The reduction of tariffs according to the plans put forward by the speaker involved State aid; but the gain would be in commercial activity being stimulated. The system of coding messages was next referred to as unfair, words unknown to any language being telegraphed. It permits a person to send ten words for one. Objection was not made to the use of the eight authorized languages, but to made-up words, which, Sir James Anderson thought, would in time drive the companies to protect themselves against the system by a high single letter tariff or a fixed code. With regard to the neutralization of cables, Sir James Anderson thought that the laying of alternate cables for times of war was not a good plan. If an existing line is cut, chartered vessels or gunboats can bridge over the cut section; and there was no doubt in his opinion that ships with telegraph cables would always follow the fleet, with the object of connecting any points telegraphically which are best calculated to insure uninterrupted communication with the base of operations or headquarters. Those new-laid lines would have the advantage of their route being unknown to the enemy, and therefore not so easily interfered with as alternative routes already provided, and therefore known to the enemy. Cutting cables in time of war did not appear to him so important as it looks at first sight.

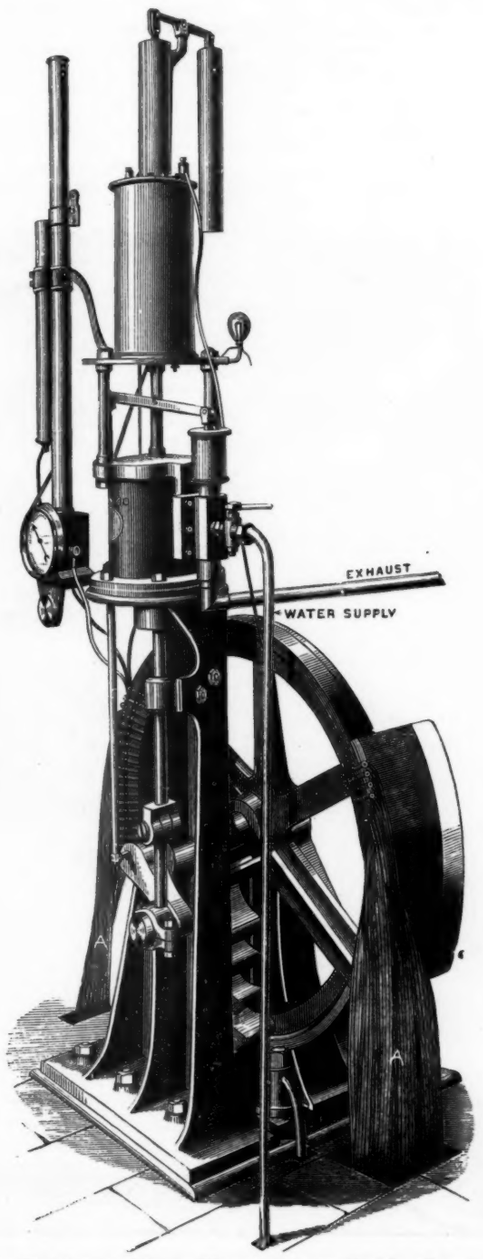

FIG. 5.—THE GORDON DIVIDED MAIN APPARATUS, USED AT PADDINGTON.

The New Telephone System.

"How is the toll system working?" was asked of J. E. Hockett, superintendent of the Central Union Telephone Company at Indianapolis.

"We have," he said, "about seven hundred telephone stations in Indianapolis. They have not, so far, proved as remunerative as we would like, but on the average will probably pay expenses. We realize the fact that business generally is somewhat dull, and hope, when the revival comes, that a greater use of instruments will be made. We had to close a number of country stations about April 1, but several of these have been reopened. We propose to furnish to outside points the same service we have always given."

TELEGRAPHIC

.... Lemuel Whitney, superintendent of the Western Union Telegraph Company, Washington, D. C., died July 23 at his home in that city.

.... Robert Cully, a lineman in the employ of the Western Union at Washington, D. C., fell from a pole thirty feet high and was almost instantly killed.

.... Sebastopol and other Black Sea ports are now protected by an electric apparatus placed in the sea to destroy hostile torpedo boats. The construction of the apparatus, which is the work of American engineers, has been kept secret.

.... That copper mining in the region of Lake Superior was carried on at a very remote period is attested by pits in which the earlier operations were carried on, and in one of which a mass of ore was found prepared for hoisting out, which weighed about eight tons. It had been hammered and chopped off until the surface had been made smooth. It lay upon sticks of oak wood, not now known to have grown in that region, and over it had accumulated a layer of gravel, fifteen feet in depth. The present race of Indians have no knowledge of the ancient miners.

.... M. Bourbouze, a French physicist, has discovered a new applica ion of aluminium, by employing an alloy of the metal with tin for the internal parts of optical instruments, in place of brass. The alloy he employs consists of ten parts of tin and 100 parts of aluminium. It is white like aluminium, and has a density of 2.85, which is little higher than that of pure aluminium. It is, therefore, comparatively light, which is an advantage for apparatus where lightness is desired. It can be soldered as easily as brass, without special means, and it is even more unalterable than aluminium to reagents.

.... The Postal Telegraph property, which was constructed in part by the issue of mortgage bonds, has during the past year been operated by Messrs. A. B. Chandler and Henry Rosener as receivers. The company has just been reorganized under the name of the Postal Telegraph Cable Company at the capitalization of $5,000,000. Mr. Chandler is president of the new company. Its lines and connections reach most of the principal cities east of the Missouri river. Its wires are all of copper or of compound steel and copper. The company has done much of the commercial business between the exchanges of New York and Chicago, and has earned the good opinion of business men for rapidity and correctness. The property of the United Lines Company has been operated in connection with the Postal by President Chandler for nearly a year past, and the two together do a great deal of the land service of the Commercial Cable Company.

.... The newly opened Canadian Pacific Railway Company has just completed a substantial telegraph line of several No. 6 gauge wires across the continent, through British territory, extending from Quebec and Montreal to British Columbia, a distance of 3,200 miles. An alliance, in the shape of a contract for the exclusive exchange of traffic, has just been concluded between the Canadian Pacific Company on the one side and the Postal Telegraph Cable Company, the Commercial Cable Company and a number of gentlemen on the Pacific coast, all of them interested in all of the three companies named. The result of this contract will be that there will be a competing line of telegraph open between New York and the principal Canadian cities, and between New York and San Francisco and all important points on the Pacific coast. Each company, under the contract, is to work its own line, but the whole system will be unified and practically operated as one. The Canadian Pacific has secured the services of Charles R. Hosmer as general manager. He is said to be one of the ablest telegraph managers in Canada.

ELECTRICAL AND SCIENTIFIC

* * The Maryland Electric Motor Manufacturing Company, of Baltimore, has filed a certificate of incorporation with James S. Calwell, of Baltimore County, Rignal W. Baldwin, William G. Wetherall, Jr., John H. Furman, John Reutland, of Baltimore, and Francis D. Canfield, of Philadelphia, directors. The capital stock is $250,000, divided into 25,000 shares of $10 each.

* * Having added to their present business in electrical goods, a branch for housework, the Electrical Supply Company, of New York, is prepared to furnish estimates for fitting private houses, offices, stores, flats, tenements, hotels, etc., with electrical work of every description, including gas lighting. Being manufacturers of this line of goods their facilities are extensive, and will enable them to do work which will give satisfaction.

* * During what portion of the day are bacteria or organic germs most numerously present in the atmosphere? Mons. Miquel, a member of the Paris Society of Public Medicine, has been trying to discover the true answer to this question, and he has found the number largest between 6 and 9 o'clock in the morning, and smallest at 2 o'clock in the afternoon. In the night he finds also a maximum at 7 and a minimum at 2. These results would indicate that the best times to open a house for ventilation would be 2 o'clock in the afternoon and 2 o'clock in the morning. This is well enough in summer, but the early ventilation will hardly be favored in winter.

Electric Light Introduced Into the Capital of Persia.

The following is written by Thomas Stevens, the bicyclist:

Coal of an inferior quality is obtained somewhere in the Elburz mountains towards Kasveen, and brought on the back of camels to Teheran, and enough gas is manufactured to supply two rows of lamps leading from the artillery square to the palace front, two rows on the east side of the palace, and a dozen or so in the square itself. The gas is of the poorest quality, and the lamps glimmer faintly through the gloom of a moonless night until nearly midnight, giving about as much light, or rather making darkness about as visible, as the same number of tallow candles would. On moonlight nights they are not lit up at all, neither is any artificial light required, for the Persian atmosphere is peculiarly transparent, and the moonlight is all-sufficient. These gas works, like the regiment of Cossacks, and a score of other things, are really expensive toys that nibble into the Shah's annual revenues, the cost of which is out of all proportion to the benefit derived. Still, the simple fact remains that gas has been introduced into the Persian capital. A simple statement to this effect without further explanation, would be quite apt to mislead people at a distance into supposing the city to be lighted with gas, and to regard the Persians as eagerly following in the footsteps of European civilization, which they most decidedly are far from doing at present. The electric light improvements consist of four lights, the height of ordinary lamp-posts, in the artillery square, and a more ornamental affair immediately in front of the palace; these are only lit up on special occasions. These electric lights, as may readily be supposed, are a never-failing source of wonder and mystification to the common people of the city and the peasants coming in from the surrounding villages. As one strolls into the square after dark, on an evening when the four electric lamps are making the gas lamps glimmer feebler than ever, each post is certain to be the center of a crowd of these people, gazing wonder-stricken up at the globe, endeavoring to penetrate the secret of its brightness and freely commenting thereon. "Mashallah! Abdullah," says one, "where does all the light come from? They put no candles in, no naphtha, no anything; where does it come from?"

"Mashallah!" replies Abdullah, "I don't know; it lights up 'biff' all of a sudden, without anybody putting matches to it or going anywhere near it; nobody knows how it comes about but Sheitan and Sheitan's children, the Ferenghis."

"Abb-ah! it is wonderful!" echoes another, "and our Shah is a wonderful being to give us such things to look at—Allah be praised!" All these strange innovations and incomprehensible things produce a profound impression on the unenlightened minds of the common Persians, and help to deify the Shah in their imagination; for although they know these things come from Frangistan—that wonderland of the Orientals whence come all the new and novel things they see—it seems natural for them to sing the praises of the Shah in connection with them. While they cannot help but recognize and acknowledge the extraordinary ingenuity of the Ferenghis in being able to make such things, they think that the ingenuity of Frangistan has been especially exercised in the Shah's behalf, and that without his power and greatness they would not have been called into existence. They think that these five electric lamps are among the wonders of the world, and the glimmering gas lamps and the electric lights help to rivet their belief that Teheran is the most wonderful city extant, and their Shah the greatest living monarch.

Digest of U. S. Patents on Storage Batteries.

REFERENCES TO FOREIGN PATENT OBTAINED THEREON.

1882.*

263,124. Aug. 22, 1882. Filed Jan. 6, 1882.
French pat., No. 144,597. Aug. 27, 1881.
Belgic pat., No. 55,632. Sept. 2, 1881.
English pat., No. 4,037. Sept. 19, 1881.
Italian pat., No. 25,409. Sept. 30, 1881.
Spanish pat., No. 2,090. Dec. 20, 1881.
N. De Kabath, Paris, France.

The electrodes consist of a number of thin sheets of lead plain or corrugated, first treated with sulphuric acid to produce a layer of sulphate of lead and then bound together. Or they may be made up of a number of plain or corrugated strips of lead bound together or braided. The elements are wrapped in parchment. The battery is formed according to the Plante reversible process.

* Omitted by error.

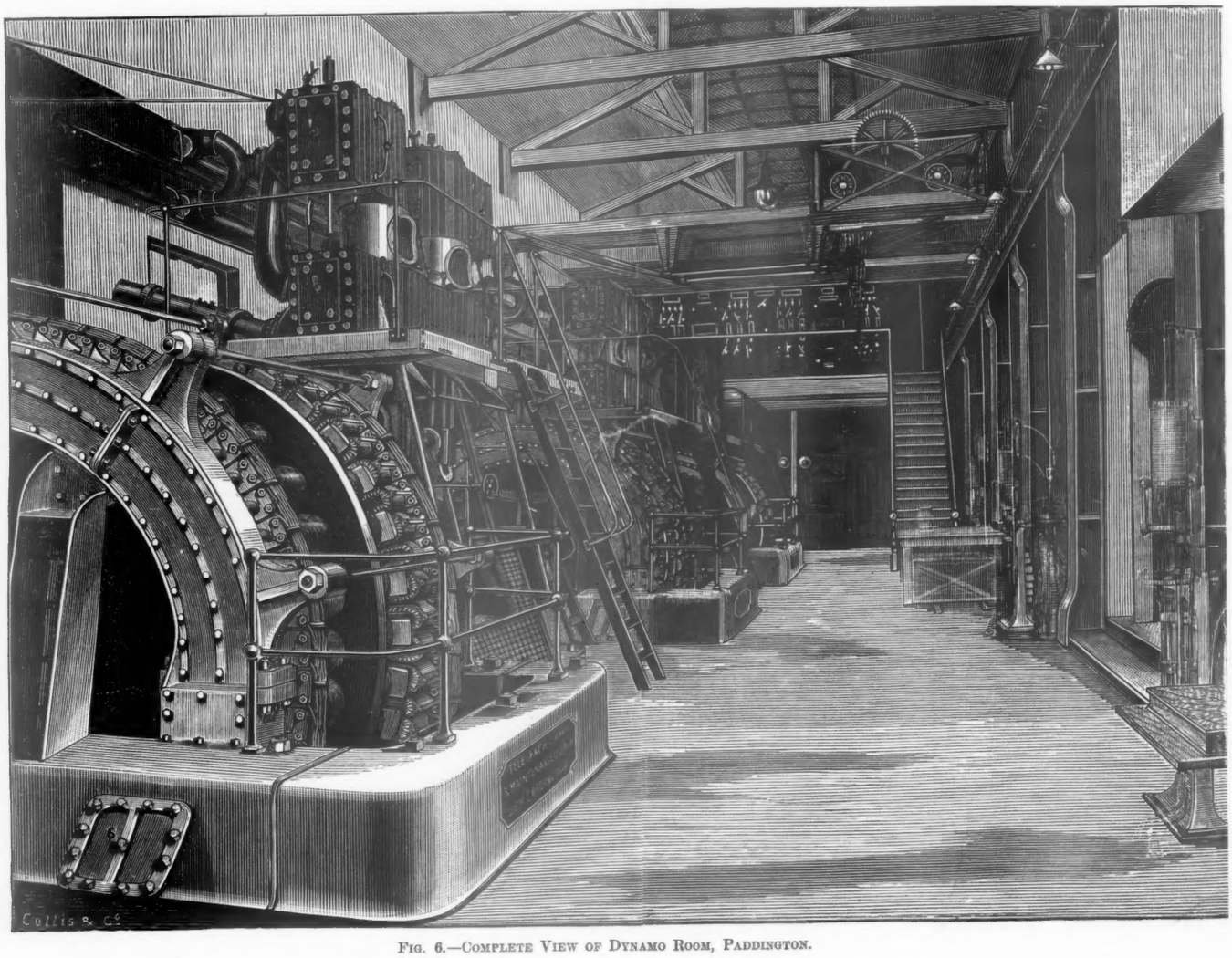

FIG. 6.—COMPLETE VIEW OF DYNAMO ROOM, PADDINGTON.

1883.

276,974. May 1, 1883. Filed Jan. 10, 1883.
Charles H. Koyl, Baltimore, Md.

Relates to an electrode composed of a hydrocarbon base and a polarizable substance—as an intimate mixture of coal tar and red lead, of liquid or pasty consistency that is run in a mold and then baked so as to form a porous plate.

277,394. May 8, 1883. Filed Dec. 19, 1881.
E. R. Whitney, Montreal, Canada.

The battery consists of a containing vessel, within which are arranged concentric chambers one within the other, and of conducting material, the outer surfaces of which are covered with a non-conducting material. These chambers are filled with lead shot, or lead shot coated with mercury and the red oxide of lead.

277,445. May 15, 1883. Filed May 1, 1882
Emil Bottcher, Leipsig, Germany.

The negative electrode is of lead foil folded or corrugated, and covered with a paste of zinc sulphate and pure litharge (Litharg-grum levigatum.) The positive electrode is of thin zinc upon which pure zinc has been electrically deposited. Acidulated water is used for the solution. The litharge is converted into peg-oxide. Upon discharge the zinc goes into solution and the per-oxide is reduced to a spongy condition.

278,638. May 29, 1883. Filed Oct. 2, 1882.
William Wallace, Ansonia, Ct.

Describes an electrode constisting of a plate of lead, on one surface of which and on opposite ends of which are arranged rows of pegs, over which is laced horizontally, across the plate, a narrow strip of lead, over which is placed a second plate of lead; the pegs may be omitted, and the strips of lead simply coiled. Between the strips of lead are inserted pieces of zinc, after which the plates are placed in a bath of acetate of lead, thereby forming lead sponge between the strips. The claim is for the method or process of forming the plate.

279,046. June 5, 1883.
Filed Feb 13, 1883.
C. M. Tomkins, N.Y.

Relates to a so-called method of "sealing" the electrodes. Over a battery is arranged a windlass, and fastened thereto by a cord is a bell-shaped cup. The negative electrode (oxygen pole) is also connected by a cord. When it is desired to "seal" the battery, the windlass is rotated, the cup descends and fits over positive element, and the negative element is lifted out of the battery.

279,346. June 12, 1883.
Filed Oct. 12, 1882.
Norman C. Cookson, Newcastle, England.

Relates to an electrode formed of lead wires coiled or folded into layers secured together by being attached at their ends to a plate of sheet lead, or the wires may be interposed between two plates of sheet lead perforated, separated, or formed as an inverted U. The lead wire is made in a specially-constructed apparatus.

The claim is for the combination of folded fine leaden wire with a perforated lead sheet or sheets.

279,839. June 19, 1883. Filed Nov. 28, 1882.
E. T. Starr, Philadelphia, Pa.

The battery consists of an outer containing vessel, provided on the inside with lugs, which support an inner vessel, somewhat smaller, the intervening space being filled with an insulating material, such as oil or powdered cork. The inner vessel is lined with lead—a plate of lead is supported by the cover of the inner cell, and is especially connected with the lining—and the two form the negative electrode (oxygen pole). The positive electrode is made up of two masses of finely-divided active material, arranged vertically, one on each side of the lead plate, and composed of lead or lead and an oxide of lead, contained within skeleton frames, which support the active masses at its edges, while the broad sides are porous or provided with perforated plates or partitions.

The claims are for the construction of the containing vessel.

281,156. July 10, 1883. Filed Sept. 26, 1882.
E. T. Starr, Philadelphia, Pa.

Construction similar to United States patent, No. 267,804, Nov. 21, 1882. The claims are for the construction of the electrode and its conducting connections.

282,396. July 31, 1883. Filed Nov. 28, 1882.
E. T. Starr, Philadelphia, Pa.

The electrodes are formed by taking finely-divided lead, or per-oxide of lead, and mixing it with a sufficient quantity of mercury to form a plastic mass, which is afterwards placed in a mould and subjected to pressure to expel excesses of mercury. In a short time, the composition becomes amalgamated into a hard self-sustaining, but porous body.

Division of application filed July 24, 1882.

282,414. July 31, 1883. Filed Feb. 8, 1883.
C. J. Vanderpoele, Chicago, Ill.

Same construction as No. 276,099, April 17, 1883.

Claim for process, consisting of first coating the respective elements with per-oxide and manoxide of lead, and afterwards combining with said coatings the black oxide of manganese, precipitated thereon by electrolytic action.

283,295. Aug 14, 1883. Filed Nov. 28, 1882.
E. T. Starr, Philadelphia, Pa.

Relates to an electrode consisting of a mixture of a finely divided metal or metallic compound, with a binding agent. The whole baked to a carbonization; mentions a paste of per-oxide of lead, coal tar and molasses, which is used to saturate cotton fiber, etc.

Division of application filed July 24, 1882.

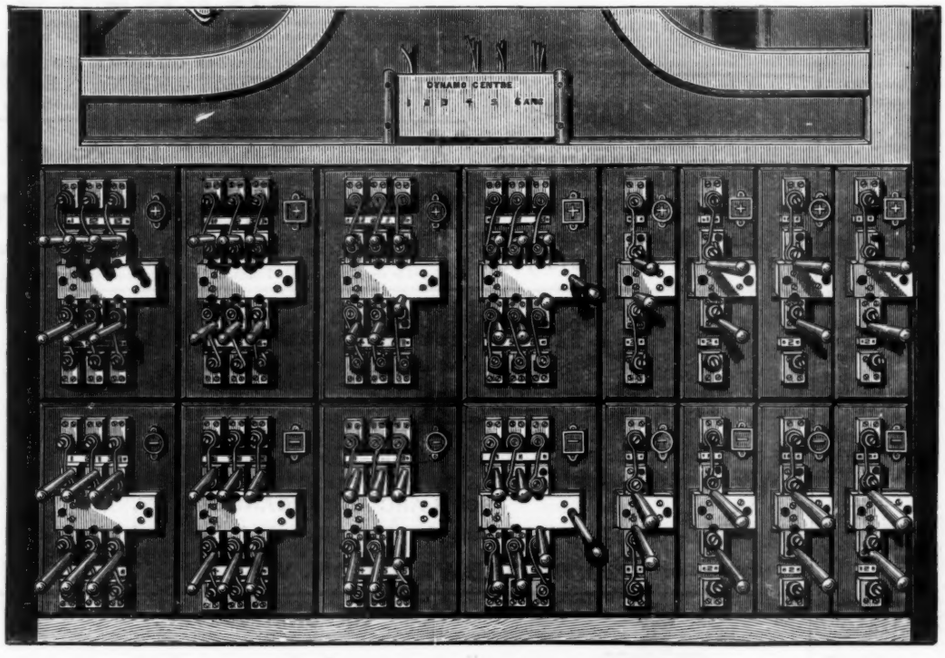

FIG. 7.—DYNAMO SWITCHBOARD USED AT PADDINGTON.

ELECTRIC LIGHT NEWS

—— Mr. W. J. Jenks has again identified himself with the Edison Company, taking charge of the Municipal Department. He is an able and progressive electrician.

—— The city of Burlington, Vt., is to have more light. The foundation for the electric light is now in order. The power will be furnished by water at Winooski Falls, some two miles distant. Many of the stores will take advantage of the new enterprise, and all of the principal streets will be thus lighted.

—— The gas company of Montreal is disposed to resent the action of the City Council in replacing its illuminant with electricity. The gas company threatens a lawsuit against the corporation, and refuses to stop lighting on streets now lighted by electricity. The Finance Committee states that the gas will not be paid for.

—— The Hartford Electric Light Company, who have been operating the Thomson-Houston system, are giving the Waterhouse system a trial, which is reported to have been very satisfactory.

—— Now that portions of the city of Troy, N. Y., are lighted by electricity, the other sections are demanding this illuminant, and the press of the city are holding the gas lamps up to the scorn of all.

—— The Mather Company have just installed a plant in the block bounded by Third and Fourth and Walnut and Main streets, Cincinnati, for commercial lighting to take the place of the Edison plant.

—— The stockholders of the Sun Electric Light Company, of Manchester, N.H., have unanimously voted to reorganize and increase the capital stock owing to the large increase of their business at Woburn, Mass. The matter has been referred to the directors.

—— The foundry and machine department of the Harrisburgh Car Manufacturing Company has been awarded the contract for engines and boilers for the large incandescent plant to be put in at Wilkesbarre, Pa. The order for present purposes comprises one 80 horse-power, and one 150 horse-power Ide automatic engines, and five 80 horse-power boilers.

—— The Bridgeport (Conn.) Electric Light Company has enlarged its facilities by putting in two new 500-light dynamos and a 90 horse-power engine. It is now prepared to furnish both arc and incandescent lamps.

—— A Denver, Colorado, company, known as the United States Electric Light Company, are reported as meeting with success in introducing their new incandescent lamp, said to have been invented by their electrician, Prof. Short.

—— The New Haven, Conn., Electric Light Company supplies over 300 lights. At a meeting of the company one day last week, it was voted to increase the capital stock from $100,000 to $150,000 to meet the constantly increasing demands of the business. During the three years of its existence there has been no change in the officers. They are: President, F. A. Gilbert; secretary and treasurer, James English; superintendent, E. K. Parker; directors, F. A. Gilbert, Jas. English, H. B. Frost, W. B. Hosmer, W. J. Atwater.

—— The circumstance that the carbon filament of a vacuum glow lamp is gradually dissipated by some electric or thermic effect of the vacuum, points to the trial of lamps in which the vacuum is discarded and its place supplied by an atmosphere of hydrogen, nitrogen, or other gas, which cannot oxidize or burn the filament. Messrs. Siemens Brothers have lately been making lamps filled with hydrogen, and they find that these lamps do not become sooty on the inner surface of the glass. Next to a filament which will remain incandescent in the open air, an envelope which will remain clean and not of itself destroy the filament is a desideratum.

—— The Stout Meadowcroft Company of this city, have just completed for the King of Corea an elegant vase of Bohemian glassware, filled with artificial flowers and illuminated with a large number of small incandescent lamps. It is a very beautiful affair, and is a portion of the plant the Edison Company are sending to that country.

—— Among the recent installations of the National Electric Service Company of their heat regulating apparatus, are the following: Isham & Lincoln, law offices, Chicago; M. B. Reamis, residence, Chicago; Henry Field (of Marshall Field & Co.), residence, Chicago; E. Hanecy, residence, Chicago; Bloomer street and Pierce street Public Schools, at Council Bluffs, Iowa; Mrs. Millbank's residence, Norwich, Conn.; Elliott F. Shepard, residence, New York; Law School of Columbia College, New York, and the residence of Thomas A. Edison at Llewellyn Park, N. J.

—— A very handsome catalogue and book of testimonials has just been issued by the Brush-Swan Electric Light Company, of New England, from its house in New York. In addition to calling attention to the acknowledged merits of this time-tried system, a long list of testimonials is published, which show the splendid reputation won by this company wherever its lamps have been used.

—— The first electric light company in New Haven organized five years ago under a special charter obtained from the legislature, was called the Connecticut Electric Light Company. It got hold of a very expensive method. After two or three years the capital was used up and the business was wound up. The plant was bought by a few of the stockholders, the rest not caring to invest any more money, and the purchasers organized the present company under the joint stock law, without any charter from the legislature, taking the name of the New Haven Electric Company. The old company had taken an interest in the patent it was working under for the entire State. This company has confined itself to New Haven entirely. It started with a capital of $50,000, and then, in order to enlarge the plant, the stockholders put in $20,000 more, and followed it up with an additional $30,000. At this time the company bought ground for works on George street and added very largely to the number of lights. The lights used were of the arc pattern exclusively until April last, when a few incandescent ones were put in. It is now proposed to call on the stockholders for $50,000 more, and, besides buying new engines and dynamos, and extending the works, to put up several new circuits providing for a large number of incandescent lights for inside use.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING JULY 27, 1886.

346,094 Electric clock movement; Silas C. Dickinson, Wilton, Iowa.

346,207 Galvanic battery; Wm. W. Le Grande, Louisville, Ky., assignor of eleven-twenty-fourths to H. R. Dering, W. W. Dering, and T. H. Upperman, all of same place.

346,217 Clutch for electric lamps; Clarence B. Noble, Cleveland, Ohio.

346,250 Underground conduit for electric wires; Frank Wheaton, New York, N. Y., assignor to the Wheaton Sub-Electric Conduit Company.

346,314 Electrical call; Edred A. Reeder, Dayton, Ohio, assignor to George F. Griffith, same place.

346,355 District telegraph; John W. Chase, Grand Rapids, Mich., assignor to Fred A. Holcomb, same place.

346,377 Telephone; Wm. C. Lockwood, Hoboken, N. J., assignor of one-half to Silas M. Stilwell, New York, N. Y.

346,388 System of lighting railway trains by electricity; Wm. A. Stern, Menlo Park, assignor to himself and Thomas A. Edison, Llewellyn Park, N. J.

346,395 Galvanic battery; Horatio J. Brewer, New York, N. Y.

346,404 Dynamometer; James Emerson, Williamsett, assignor of two-thirds to Carl A. Thissell, Lowell, Mass.

346,414 Machine for winding lead tape upon telegraph cables; Wm. R. Patterson, Chicago, Ill., assignor to the Western Electric Company, same place.

346,430 Electric arc lamp; Elisha B. Cutten, Pittsburgh, Pa., assignor to the Electrical and Mechanical Developing Company, same place.

346,433 Machine for winding red tape upon telegraph cables; Francis P. Duplain, Chicago, Ill., assignor to the Western Electric Company, same place.

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A. C. FOWLER, C.E., was Examiner in the U. S. Patent Office from 1880 to 1885, in the Interference and Electrical Divisions.

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ELECTRICAL CASES A SPECIALTY.

SPECIAL NOTICE.

National Electric Light Association,

SEMI-ANNUAL MEETING.

THE FOURTH MEETING—semi-annual—of the NATIONAL ELECTRIC LIGHT ASSOCIATION will be held at DETROIT, MICH., on Tuesday, 31st day of August, at 10 o'clock, A.M. Dues being payable in advance, all members are required to forward the same for the year 1886, by check or otherwise, payable to the order of J. F. MORRISON, President, Baltimore, Md.

Electric Light Companies and Manufacturers of Electric Light Apparatus, Supplies, &c., desiring to become members, must apply on or before August 31st, to the President, J. F. MORRISON, Baltimore, Md.

Members and others desiring information as to R.R. transportation rates will address J. F. NOONAN, Esq., Chairman Com. on Transportation, Paterson, N. J.

Special Hotel rates will be made known previous to meeting of the Association.

A. J. DeCAMP, Chairman Ex. Com.
Philadelphia, Pa.

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The best Substitute for Hard Rubber for all Electric, Insulating and Mechanical Purposes, costing less than any other insulating material of its class. Furnished in Sheets and Tubes of various thicknesses.
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Platinum in sheet and wire, all sizes, and any degree of hardness. Scrap and native platinum purchased.

PHOENIX GLASS COMPANY,
(Works, Water Cure, Beaver County, Penn.)

Fig. 255

Fig. 259

—MANUFACTURERS OF—
A FULL LINE OF ELECTRIC LIGHT GLOBES & SHADES,
BOTH ARC AND INCANDESCENT,
In Opal, Flint and Art Glass Effects, in Opalescent and other Colors,

Fig. 260

A. H. PATTERSON, Manager. 729 BROADWAY, COR. WAVERLEY PLACE, NEW YORK.

THE ONLY GENUINE
LECLANCHÉ DISQUE BATTERY
IS THAT MADE BY
THE LECLANCHÉ BATTERY COMPANY.

GENUINE DISQUE CELL, COMPLETE.
The Porous Cell also bears Label.

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All others are imitations.
DO NOT BE IMPOSED UPON.
IF DEALERS HAVE NOT THE GENUINE BATTERY. SEND DIRECT TO US FOR PRICE LIST.
None of the Imitations Compare with it in Efficiency.
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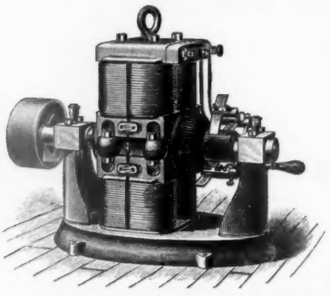

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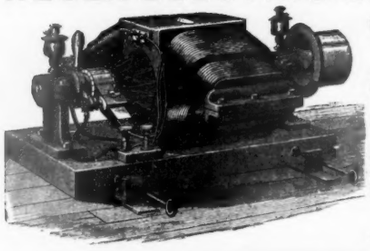

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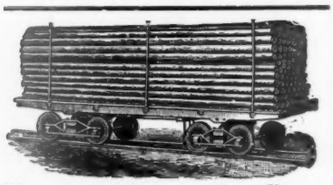

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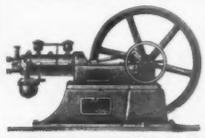

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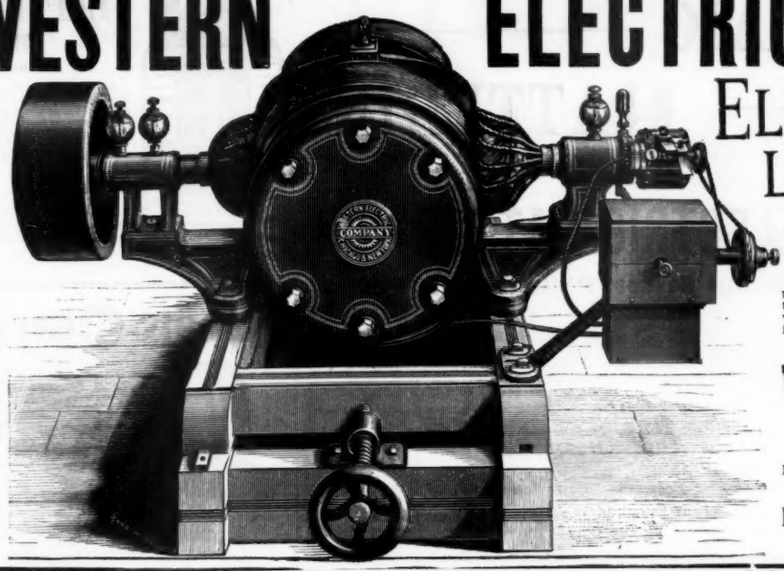

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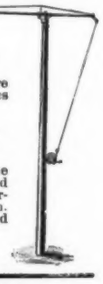

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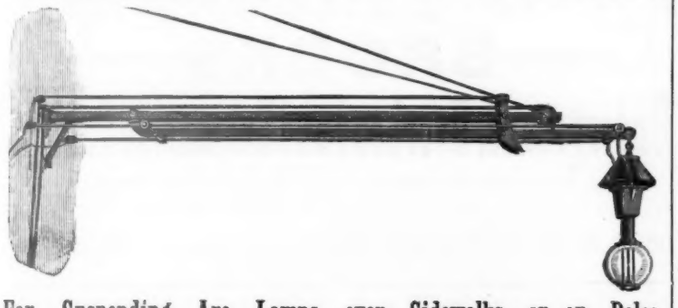

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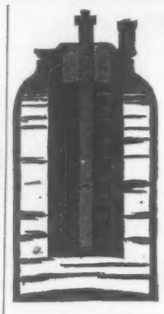

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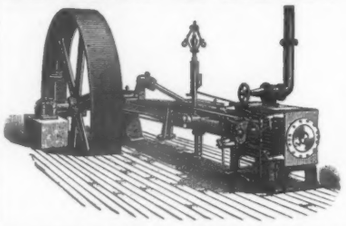

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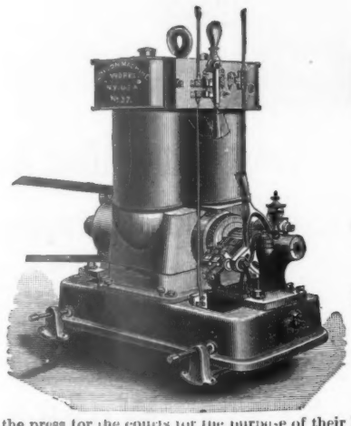

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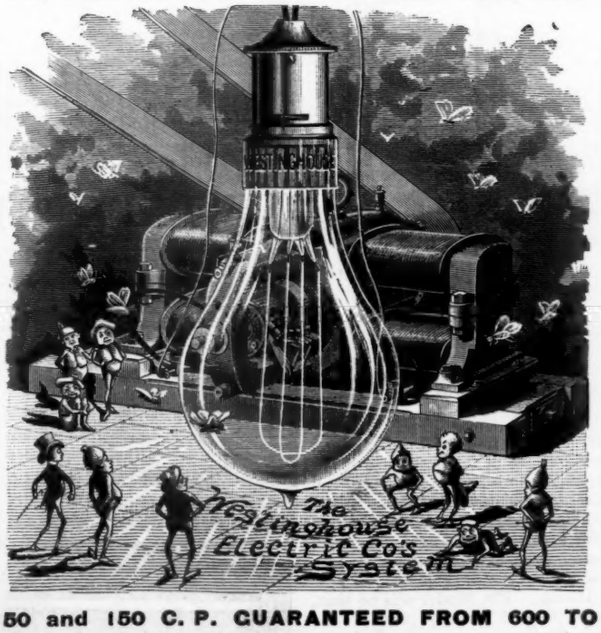

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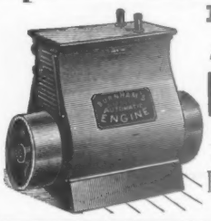

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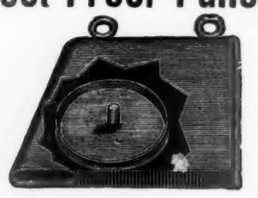

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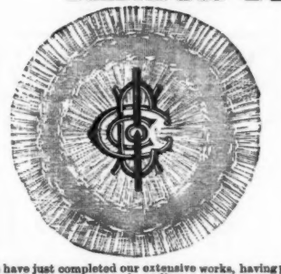

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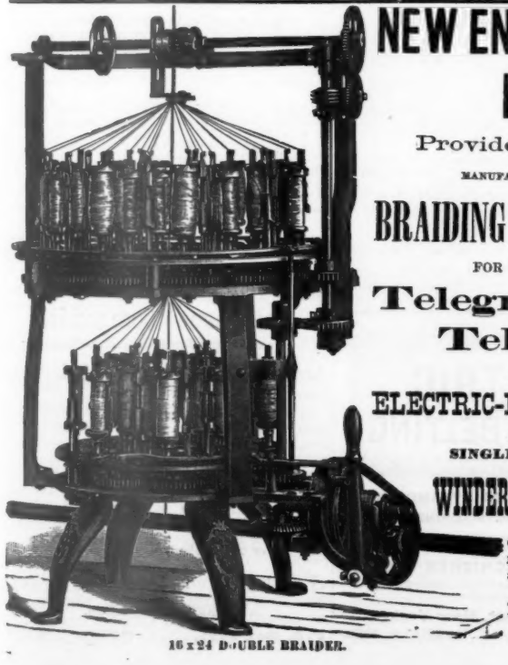

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